PROGRESS ON REVIVING LUNAR ORBITER: SCANNING, ARCHIVING, AND CARTOGRAPHIC PROCESSING AT USGS. T. Becker, L. Weller, L. Gaddis, D. Soltesz, D. Cook, A. Bennett, D. Galuszka, B. Redding, J. Richie, Astrogeology Team, U.S. Geological Survey, 2255 N. Gemini Drive, Flagstaff, AZ (tbecker@usgs.gov).

Introduction: Lunar Orbiter (LO) images were photographic products acquired on the spacecraft in five missions (LO-I through -V) while in orbit over the lunar surface in the late 1960's. LO data were transmitted to Earth as analog data after onboard scanning of the original film into a series of strips. We report on our ongoing effort to digitize, archive, and process a subset of these LO photographic data [1, 2, 3]. The results of this work will be a global, cartographically accurate, cosmetically enhanced, digital photographic mosaic of the Moon. This LO mosaic will be coregistered to the Clementine 750-nm global mosaic [4].

In addition to digitizing medium- and high-resolution LO data for global coverage, we are now scanning and processing a selected subset of the very high-resolution (VHR) data acquired by LO missions III and V [5].

Global Project Update: Digitization of LO data for optimum global coverage was completed in June 2003. Global coverage includes 160 high-resolution (HR) frames and 45 medium-resolution (MR) frames acquired by LO missions III, IV, and V. Ground resolution of this global dataset range from 60 to 100 meters for the HR data and 500 to 1000 meters for the MR data. LO-IV systematic HR near side data comprises 88% of the global dataset. Approximately 17,000 35-mm film strips were scanned at 25-micron resolution. Scanned data are archived in-house on DVD volumes and these contain ~265 Gigabytes of "raw" LO data. Digital film strips are averaged to 50-micron resolution for construction of the HR frames (96 strips each) and MR frames (~32 strips each). As in Bowker and Hughes [6], the HR frame mosaics are processed in three sub-frame segments.

As they are produced, constructed LO frames for the global product are being made available at 100-micron resolution on the LO Web site of the U.S. Geological Survey Astrogeology Program http://astrogeology.usgs.gov/Projects/LunarOrbiterDigitization/. This site provides lunar maps showing the outline boundary coverage of each LO frame and corresponding frame-number labels. Users can select a frame number and the constructed frame (or subframes) are displayed at thumbnail resolution with the option to select higher resolutions for display and/or download.

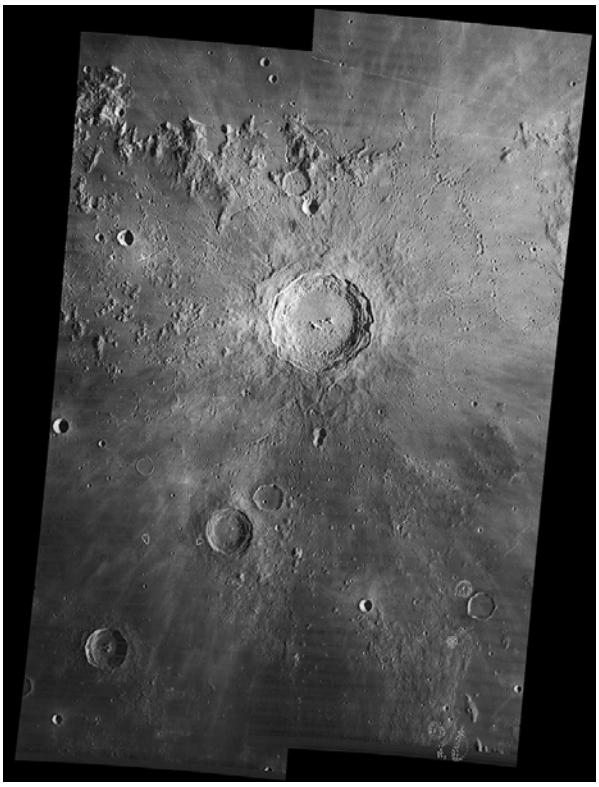
Global Cartographic Control: Construction of a global mosaic using LO digital frames is currently underway using USGS ISIS [7, 8, 9] software and camera models for LO missions III, IV and V. Global mosaic development involves the establishment of geometric control for individual LO frame mosaics through collection of tie-points between LO and Clementine 750-nm image tiles, iterative triangulations to update LO spacecraft pointing information, rectification of the LO frames to a map projection, and mosaic construction.

VHR Project Update: LO missions III and V collected hundreds of high-quality VHR frames of the lunar near side equatorial region [5]. Ground resolutions for these VHR data range from 1 to 5 meters/pixel for the HR camera and 10 to 40 meters/pixel for the MR camera. We are now scanning a subset of about 25% of the VHR LO III and IV data. These VHR frames were selected on the basis of image quality and scientific utility. Depending on community interest and available resources, additional VHR frames may be scanned and processed in the future. As with the global project, constructed VHR frame mosaics will be made available online following validation.

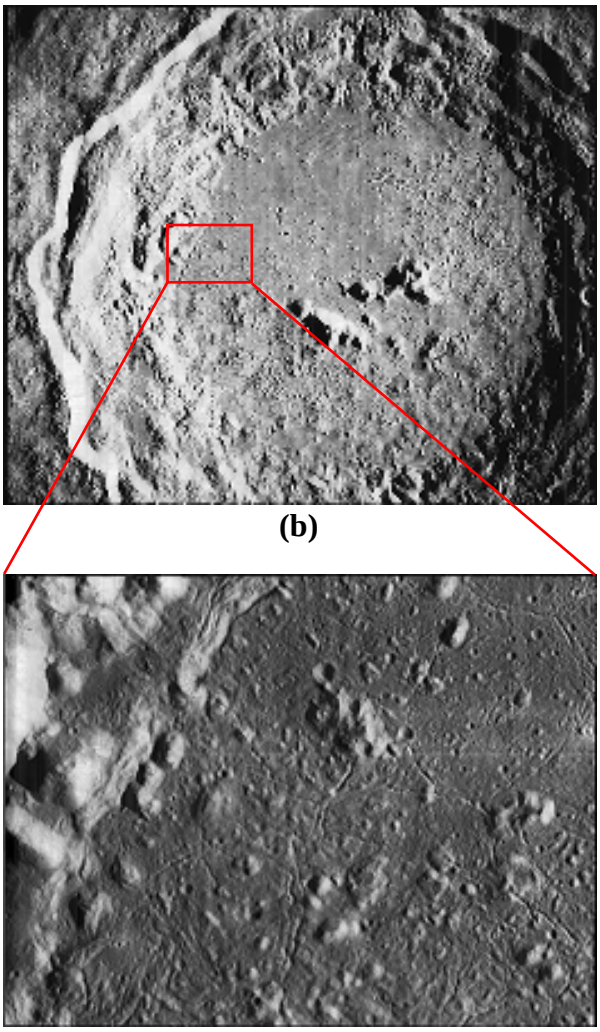
Summary: These high-spatial resolution digital LO mosaics provide an outstanding complement to numerous other digital geochemical, geophysical, and multispectral lunar data. For example, in digital form the LO mosaics are strikingly complementary to the Clementine color data (***Figure 1***). When combined with other digital data, the LO data provide unparalled, detailed views of the lunar surface that will be useful for lunar studies for years into the future. The historic LO photographs provide low-sun-angle views of the Moon that enhance our ability to see subtle topographic and morphologic features such as lava-flow lobes in Mare Imbrium, mare/highland contacts, and flow features in the floor of Copernicus crater (***Figure 2***). Finally, these high- and very-high resolution LO data provide a firm foundation for potential future missions of lunar exploration and characterization.

References: [1] Gaddis et al., 2001, LPS XXXII, #1892. [2] Lunar Orbiter Pilot Project: http://astrogeology.usgs.gov/Projects/LunarOrbiterDigitization/. [3] Gaddis et al., 2003, LPS XXXIV, #1459. [4] Eliason et al., 1999, Mission to the Moon, The Clementine UVVIS Global Mosaic, PDS CL_4001-4078. [5] Hansen, 1970, Guide to Lunar Orbiter Photographs, NASA SP-242. [6] Bowker and Hughes, 1971, NASA SP-206. [7] Torson et al., (1997), LPS XXVIII, 1443. [8] Eliason, (1997), LPS XXVIII, 331. [9] Gaddis et al. (1997), LPS XXVIII, 387.

Figure 1. Copernicus crater (93.0 km, 9.7N, 20.1W). Co-registered LO IV (Frames 126H2 & 121H2) and Clementine color ratio data (red=750/415; green=750/950; blue=415/750).



(a)



(b)

(c)

Figure 2. (a) Mosaic of LO-IV Frame 126H1/H2 and LO-IV Frame 121H1/H2 centered on Copernicus crater and surrounding region. (b) LO-V Frame 152M showing interior and portion of the rim of Copernicus crater. (c) LO-V Frame 152H3 showing very high-resolution view of the floor of Copernicus crater. Note drapy texture of impact melts.